B-jet Physics: Energy Loss

Huang, Kang, Vitev: hep-ph/1306.0909
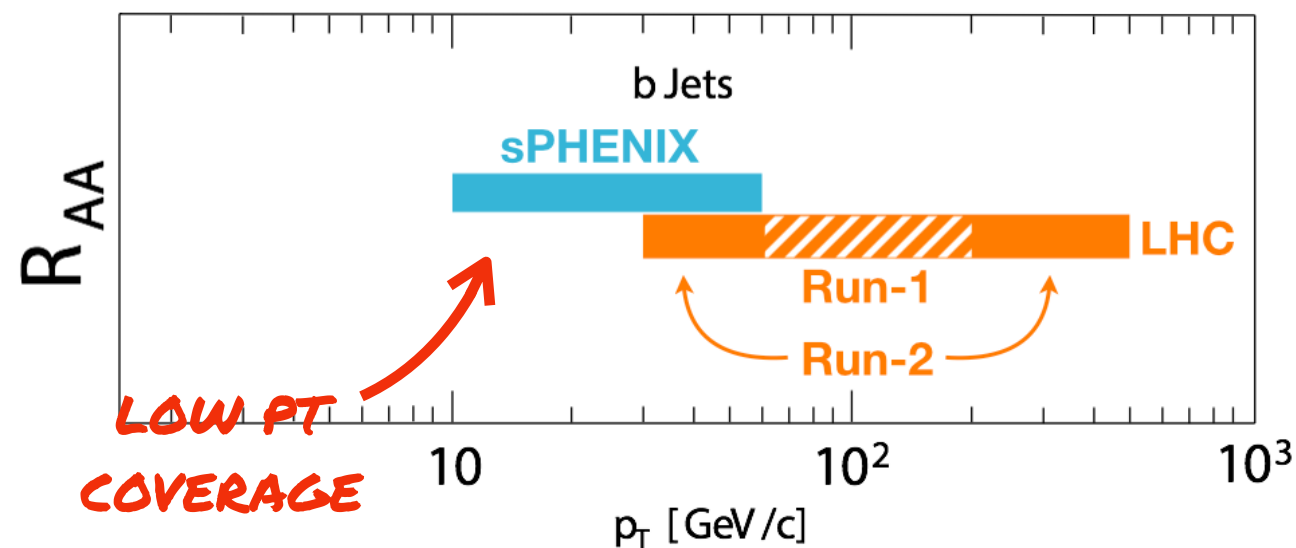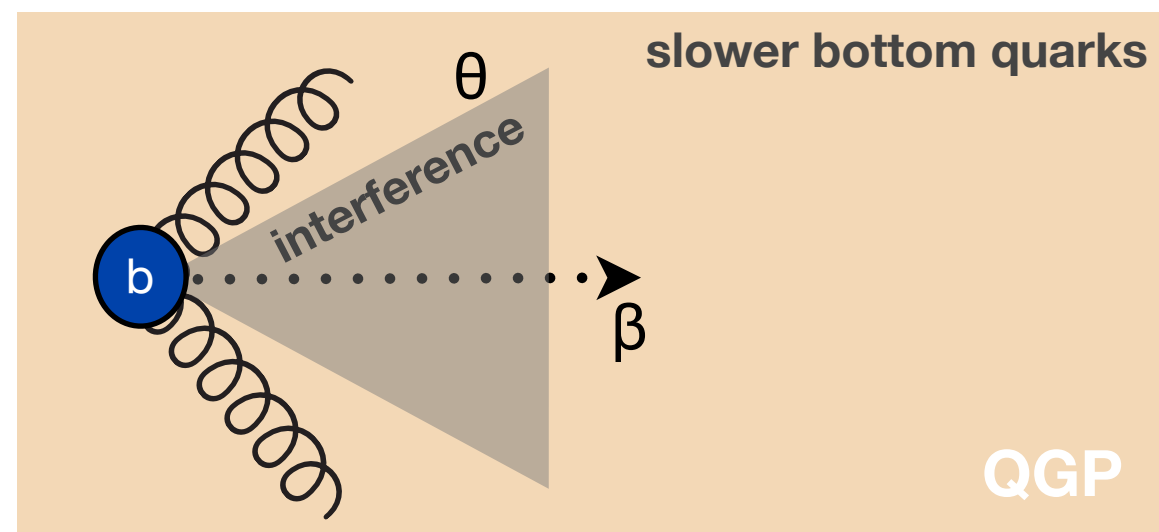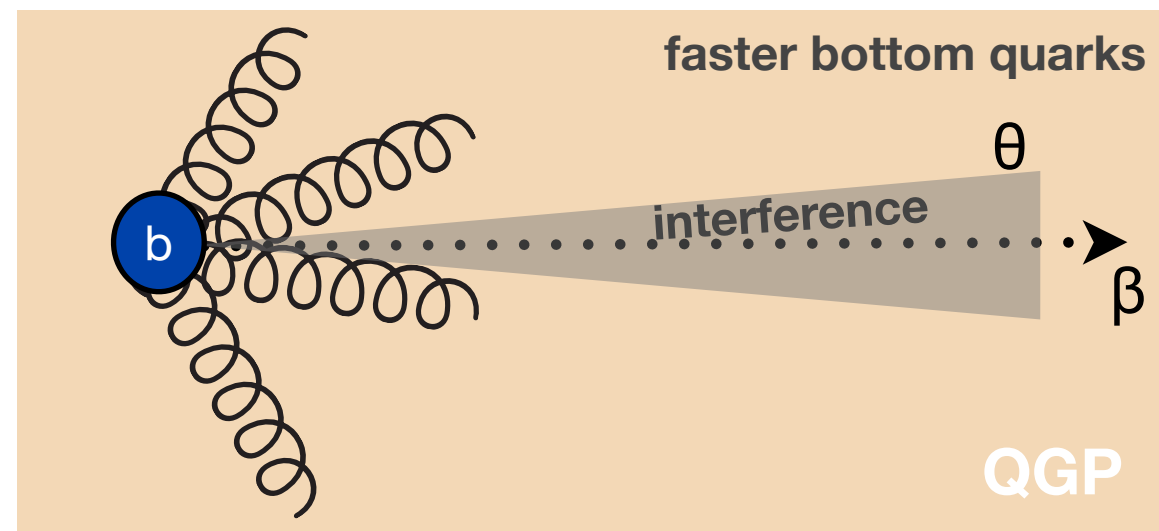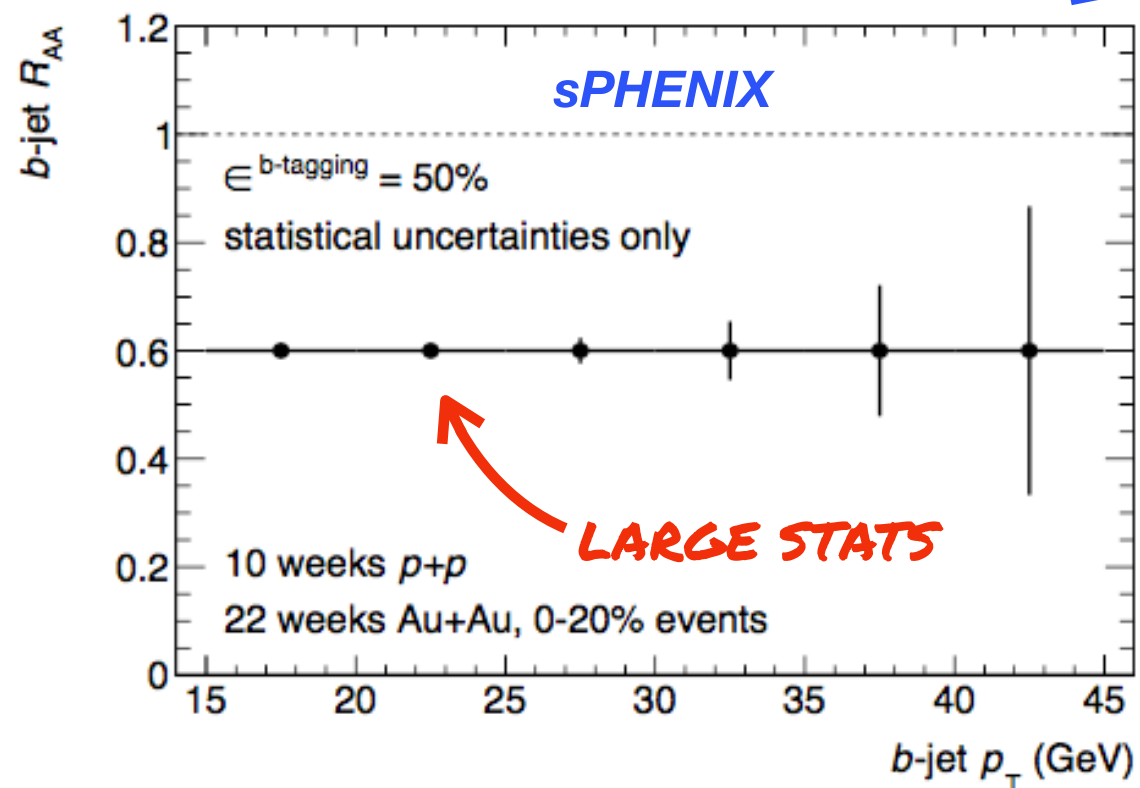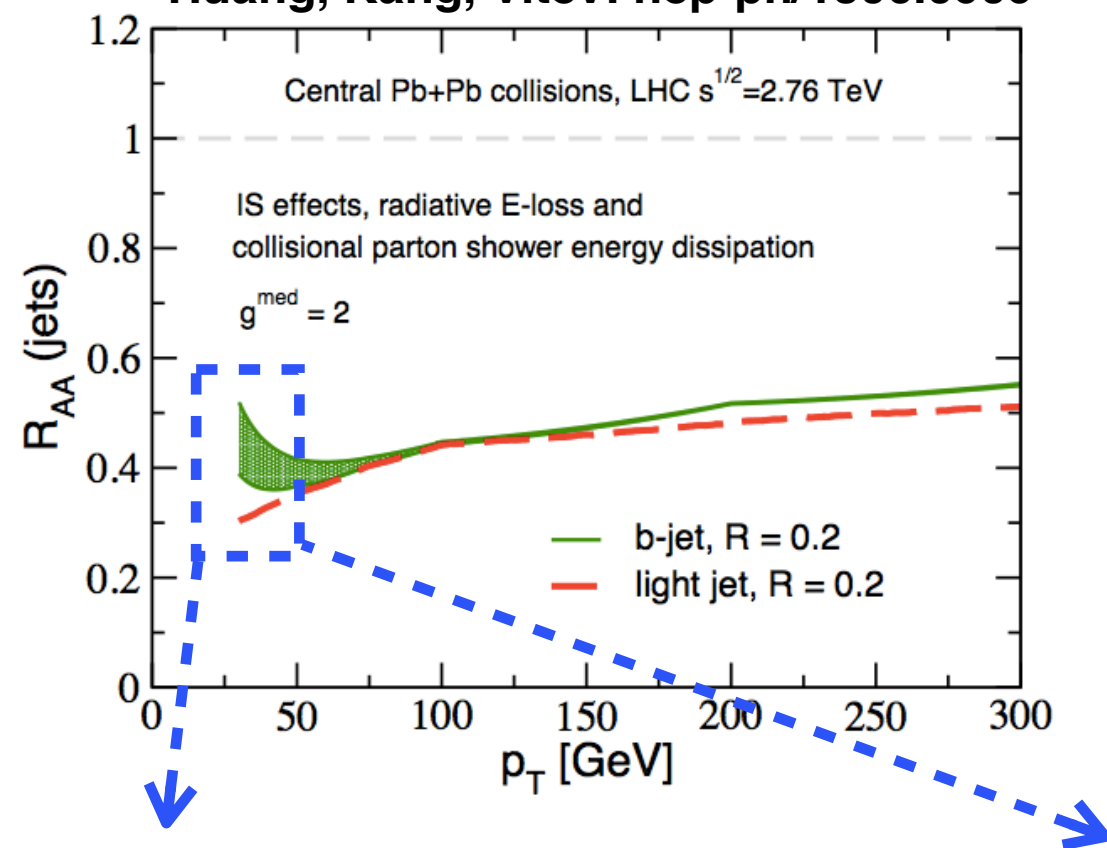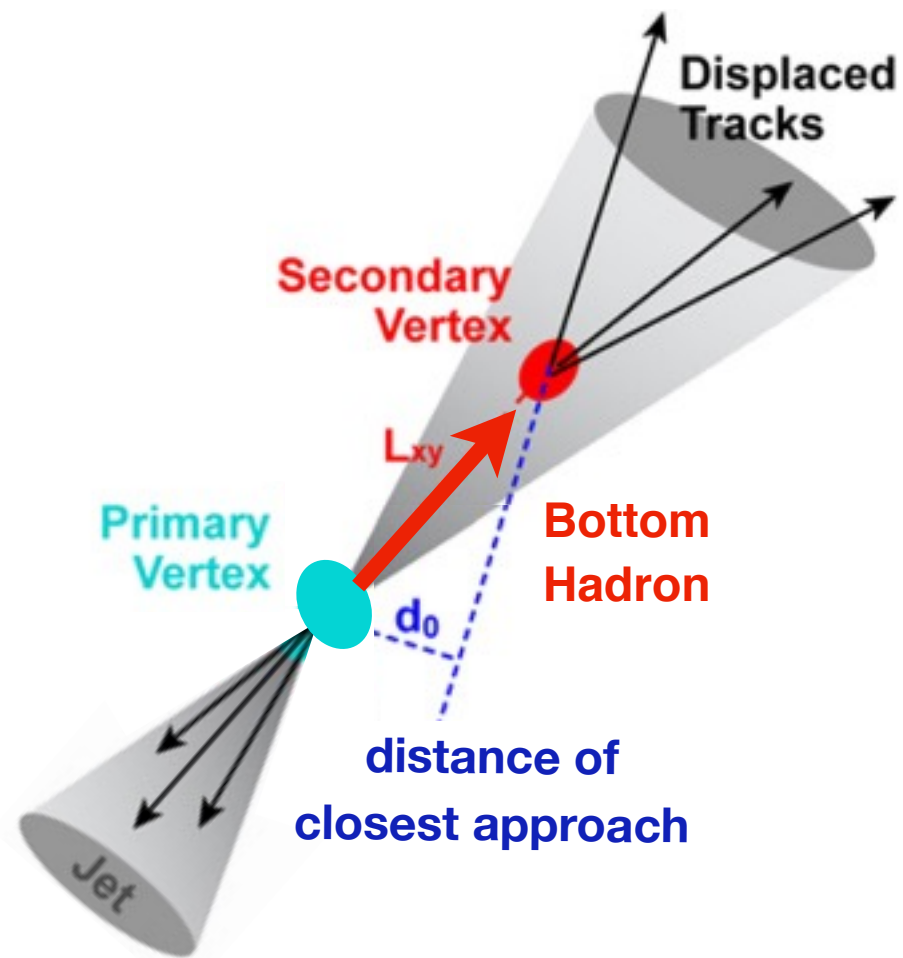
Central Pb+Pb collisions, LHC $s^{1/2}$=2.76 TeV

IS effects, radiative E-loss and collisional parton shower energy dissipation

g^{med} = 2

— b-jet, R = 0.2
— — light jet, R = 0.2

R_{AA} (jets)

p_T [GeV]

sPHENIX

b-jet R_{AA}

$\in^{b\text{-tagging}}$ = 50%

statistical uncertainties only

LARGE STATS

10 weeks p+p
22 weeks Au+Au, 0-20% events

b-jet p_T (GeV)

faster bottom quarks

b

θ

interference

β

QGP

slower bottom quarks

b

θ

interference

β

QGP

b Jets

sPHENIX

LHC

Run-1

Run-2

R_{AA}

LOW PT COVERAGE

p_T [GeV/c]

sPHENIX should have access to 3 different techniques for heavy-flavor identification:

(1) Semi-leptonic decay

(2) Multiple Large DCA tracks

(3) Secondary Vertex Mass

Big push from DVP for sPHENIX proposal

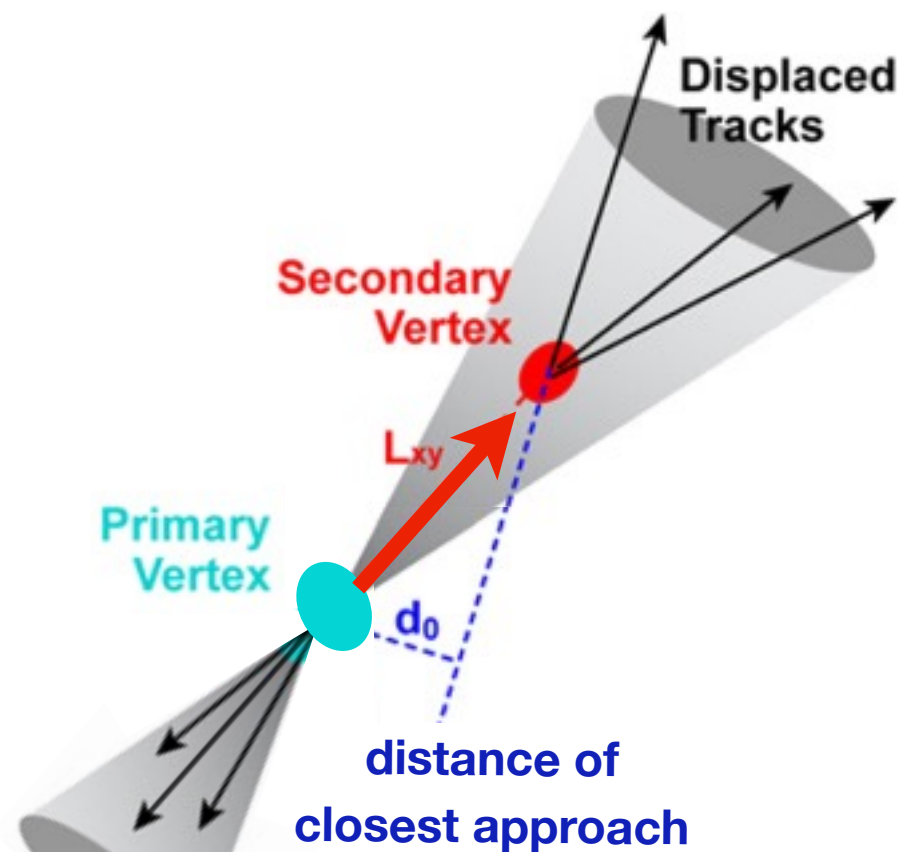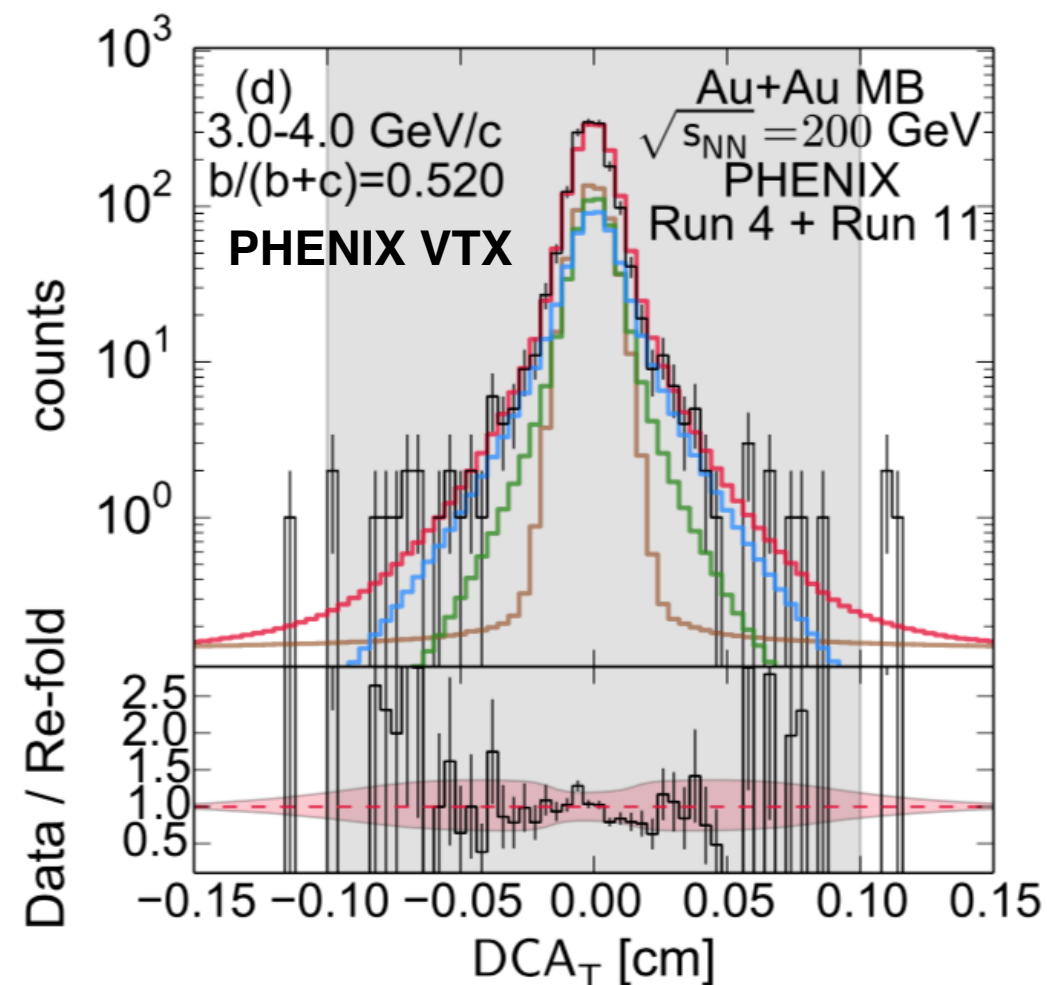**Unexplored thus far!**

B-jet Identification Methodology

sPHENIX should have access to 3 different techniques for heavy-flavor identification:

(1) Semi-leptonic decay

(2) Multiple Large DCA tracks
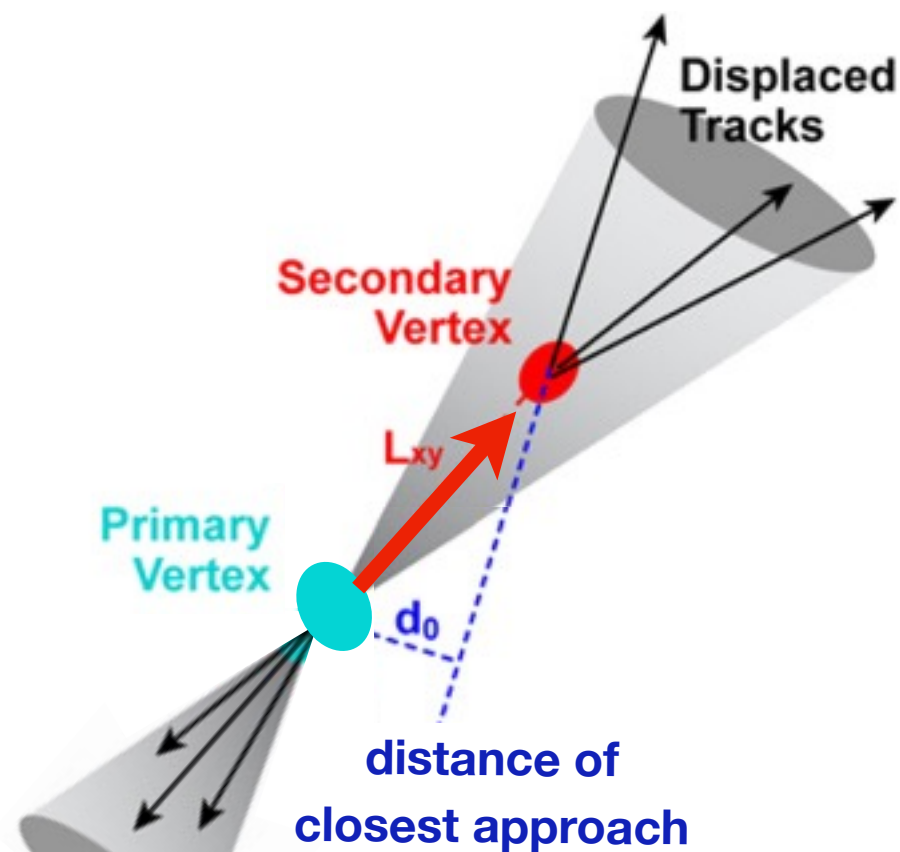
(3) Secondary Vertex Mass

Semi-leptonic decay requirements:
Electron identification at large p_T
Narrow primary electron DCA distribution

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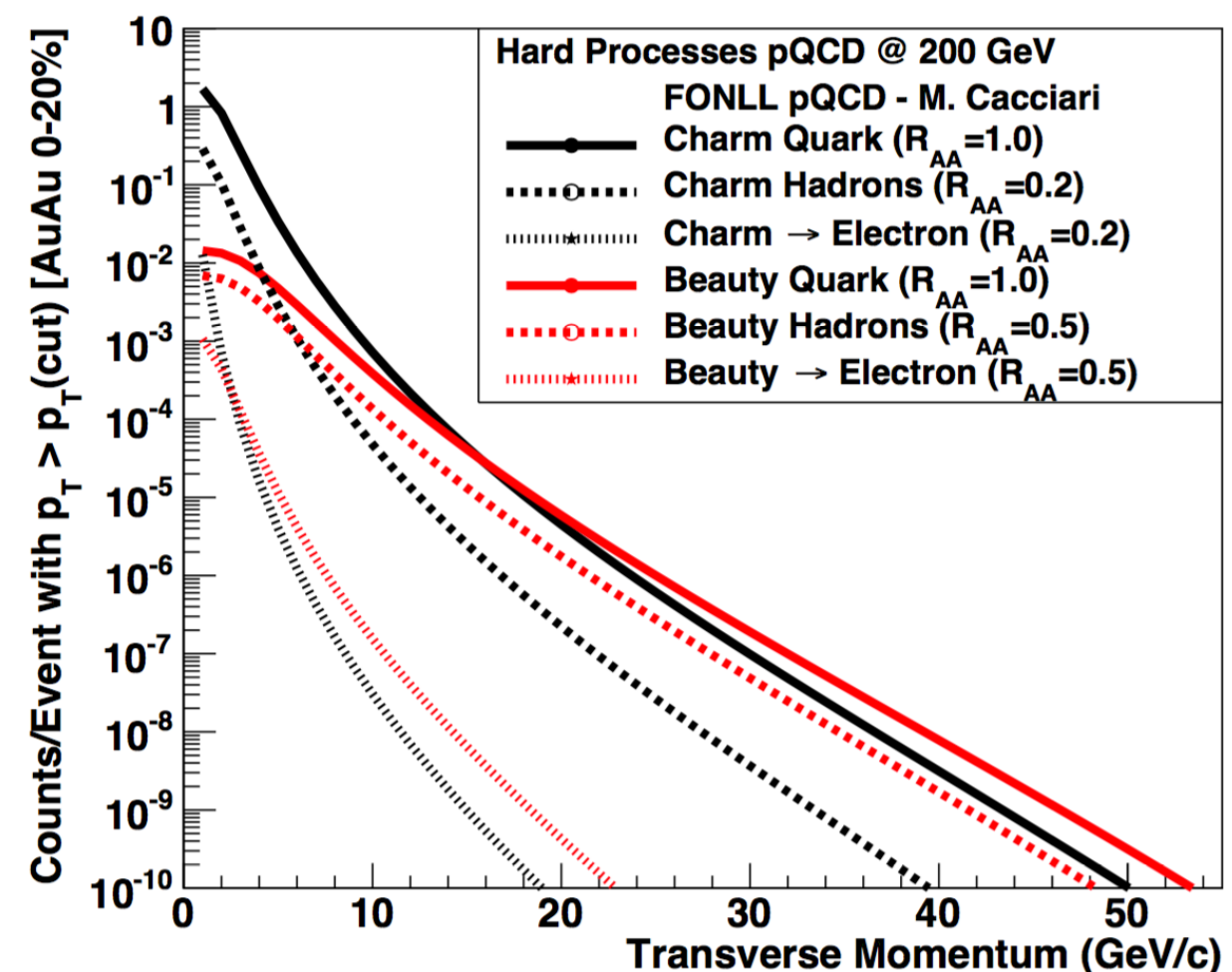(3) Secondary Vertex Mass

Semi-leptonic decay requirements:
  Electron identification at large p_T
  Narrow primary electron DCA distribution

Downside: Large reduction in B-jets if only the semi-leptonic decay channel is used

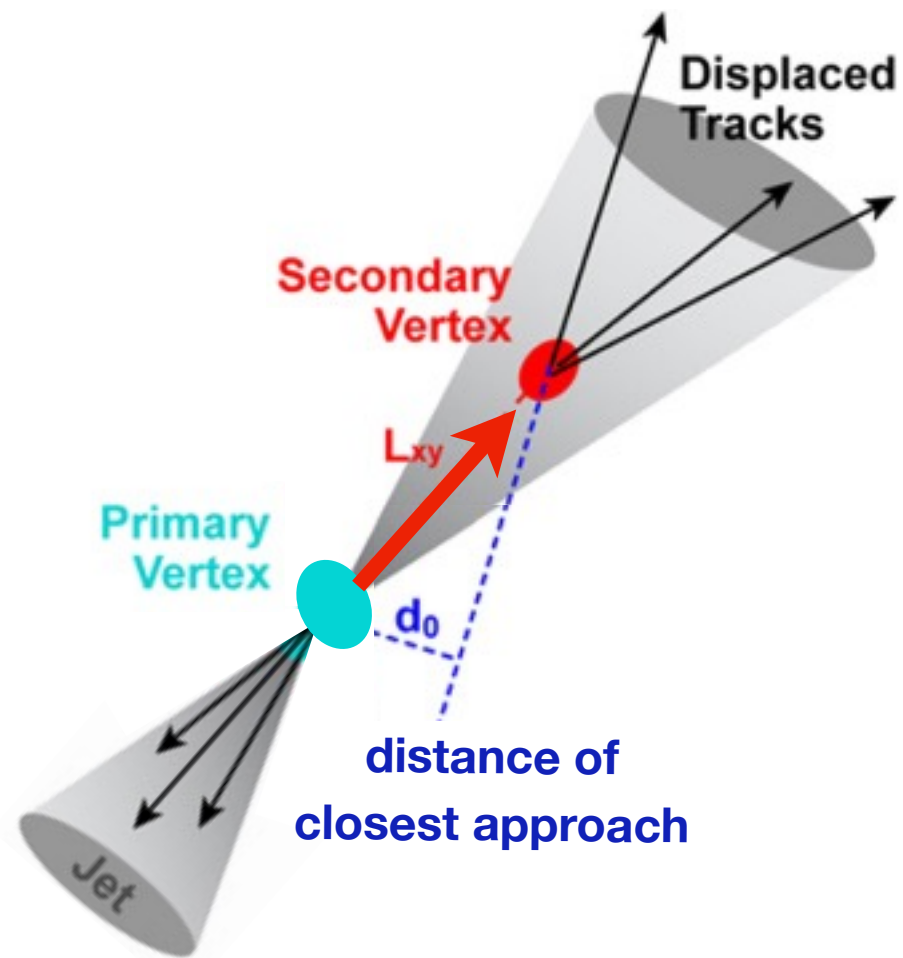*Unclear if this is a viable route to b-jets*
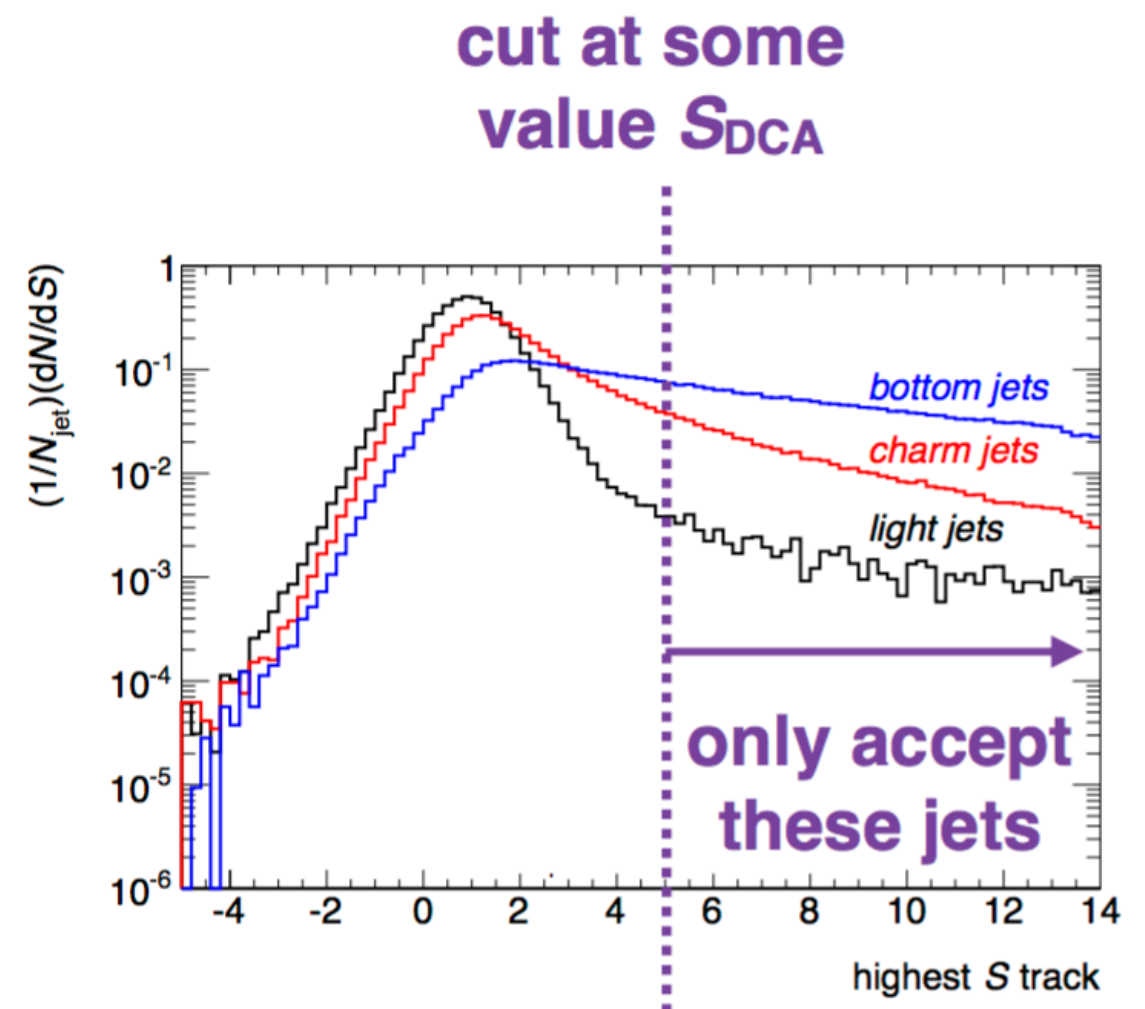
B-jet Identification Methodology

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Track Counting requirements:

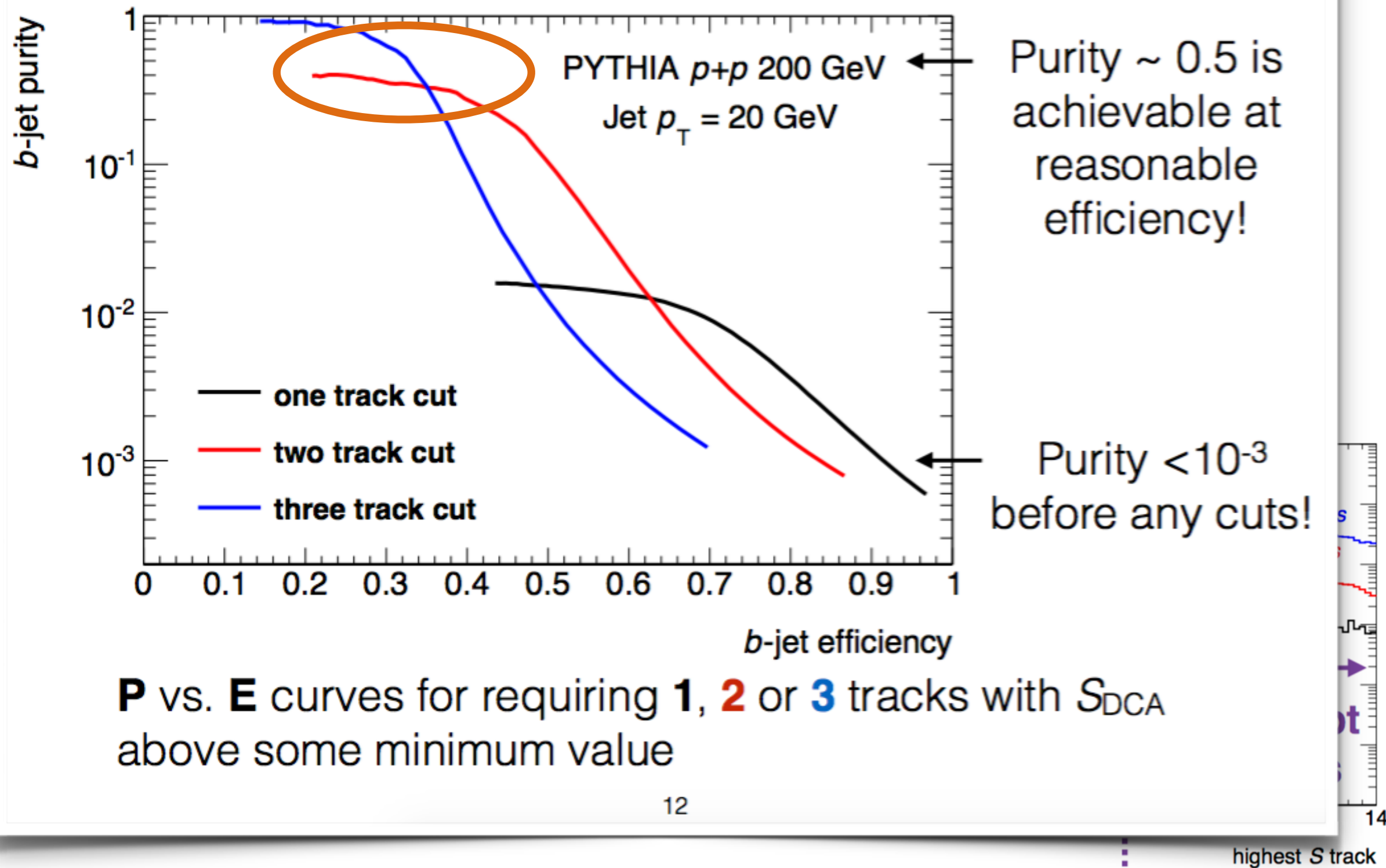Large single particle reconstruction efficiency, $\sim \epsilon^N$
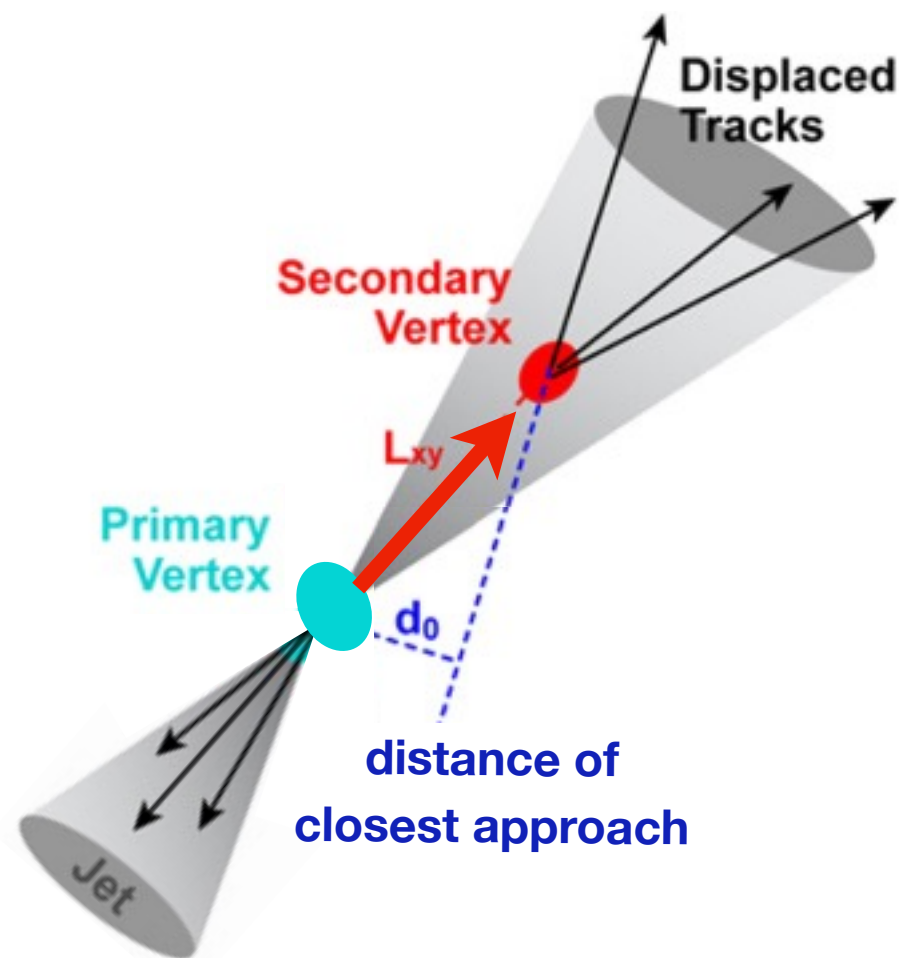
Narrow primary hadron DCA distribution (<70um)

from the April Review…

b-jet performance in *p+p*

PYTHIA *p+p* 200 GeV

Jet p_T = 20 GeV

- one track cut
- two track cut
- three track cut

Purity ~ 0.5 is achievable at reasonable efficiency!

Purity <10^{-3} before any cuts!

b-jet purity

b-jet efficiency

P vs. **E** curves for requiring **1**, **2** or **3** tracks with S_{DCA} above some minimum value

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highest *S* track

B-jet Identification Methodology

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(1) Semi-leptonic decay
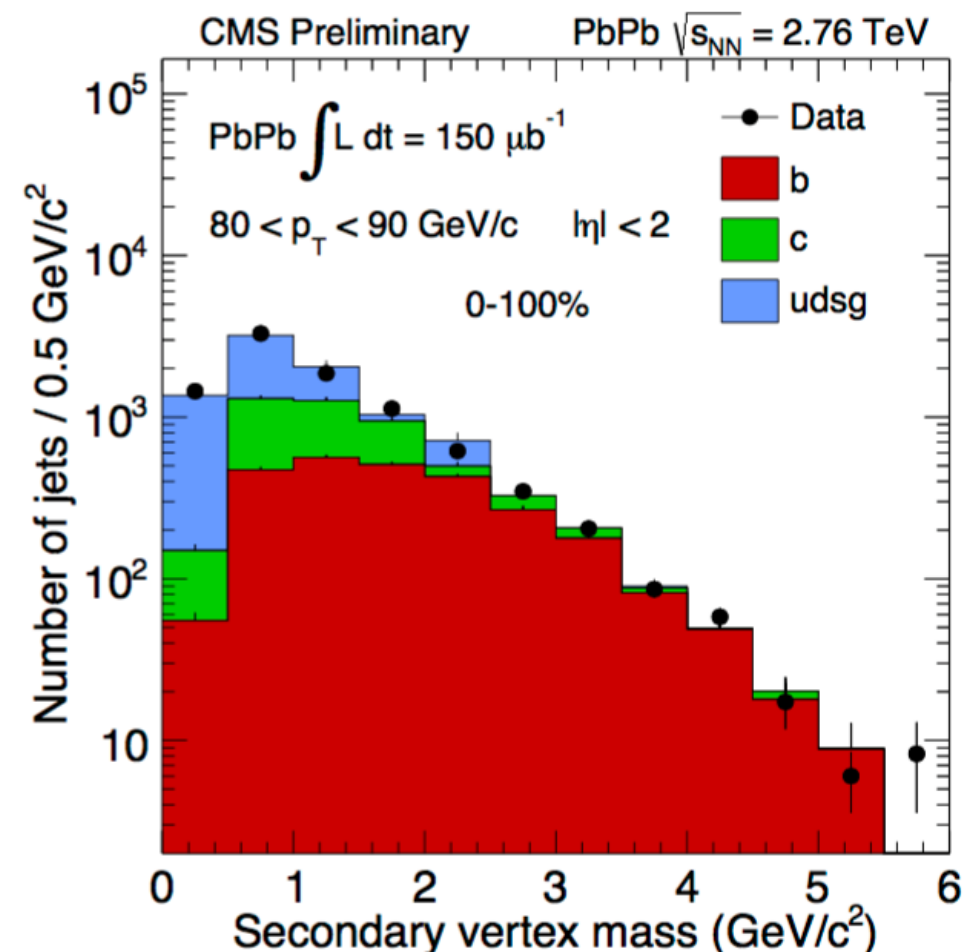
(2) Multiple Large DCA tracks

(3) Secondary Vertex Mass

Secondary Vertex requirements:

Large single particle reconstruction efficiency, $\sim\epsilon^2$

Individual track position resolution

CMS b-jet Performance

from the April Review…

b-jet efficiency and purity in Pb+Pb
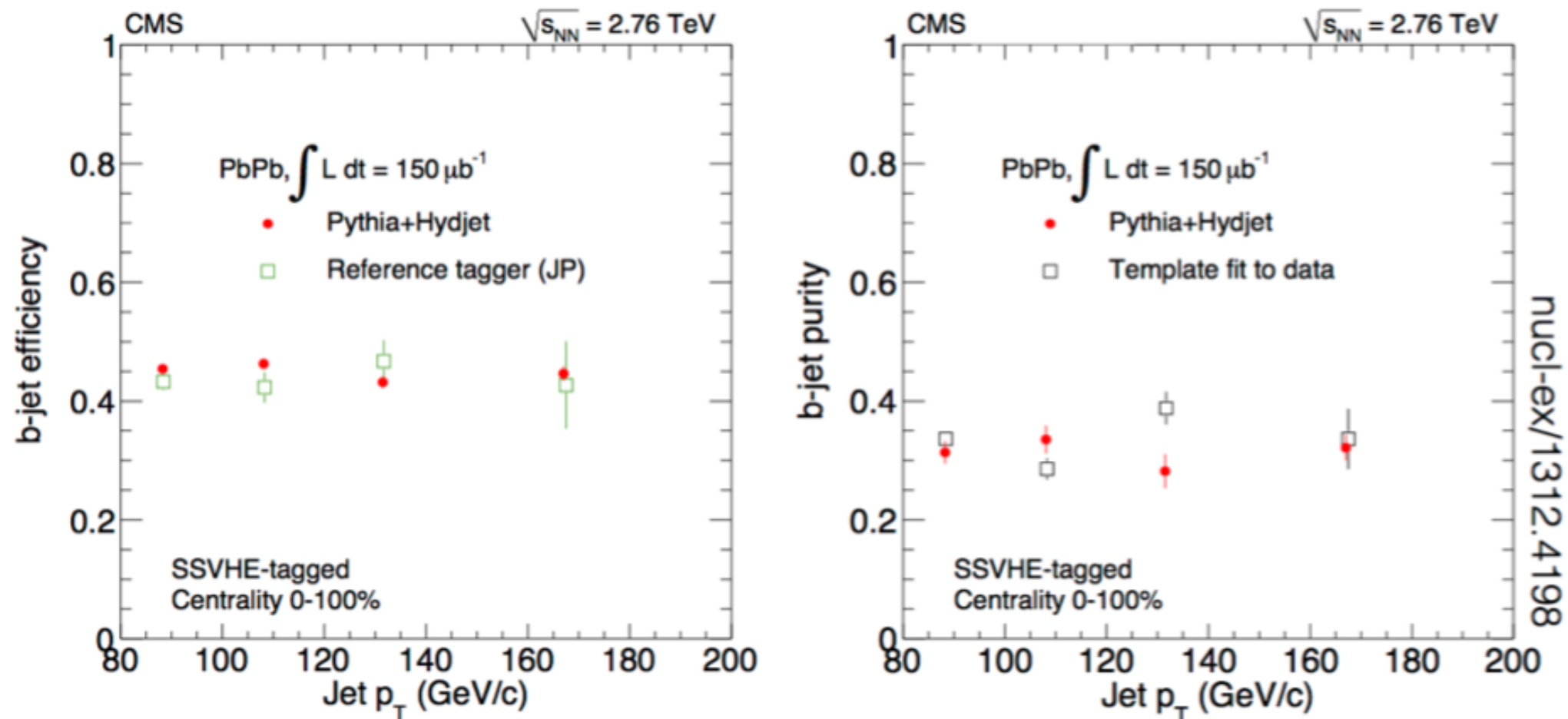
≈*45% Efficiency* and ≈*35% Purity* in the CMS *b*-jet spectrum in Pb+Pb

➡ comparable to that achievable with 2- or 3-track TrackCounting cuts

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